

PRINCIPLES OF FOREST MANAGEMENT

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Although the South possesses the best natural conditions in the world for growing timber crops, Southern timberlands produce less than one-third of their potential crop of timber products. The explanation lies in the present lack of management on most Southern timberlands.

Southern timberlands are a challenge to farsighted men who believe in the future of the South and who wish to invest in the development of one of its greatest natural resources. Through good management, neglected Southern timberlands may be made to produce three to four times their present volume of forest products--while their value is increased in proportion.

The cropping of timberlands differs essentially from other types of agriculture in the age of the crop at harvest. In forest management, although we plant and harvest annually, we deal with a crop that requires many years to mature. This long period between planting and harvesting requires a different approach and different techniques from those used in other farming operations.

In this article a few of the principles and concepts of forest management will be discussed, together with some applications to Southern timberlands.

GROWING STOCK

Forestry, like agriculture, is dependent on the soil and climate for production; forestry, however, depends also on an adequate, well-formed stocking of trees of all sizes. To be successful and attractive, forestry must produce a return not every 30, 40, or 50 years, but annually—or at least at short intervals. So, a well-managed forest should have mature trees, and trees that will mature in a few years. Further, it should have ample smaller stock, trees that will reach cutting size in 10, 20, or 30 years. Only by thus providing for the future can the forest manager assure for the continuity of his operation.

The job of the forest manager is primarily the manipulation of growing stock, building it up where it is scant, providing reproduction for the future, improving the quality and growth of young stands through judicious cuttings, and, finally, determining the proper size and age to harvest trees at maturity. The forest is ordinarily responsive to treatment, where the objective of management is clear and the practices are consistent with the objective.

Although the average forest owner will seldom harvest the reproduction he protects and encourages, it is still to his advantage to keep reproduction needs in mind. Soon the sale value of a managed forest will depend not so much on the value of the growing stock if thrown on the market, as on the ability of the stand to produce a continuous supply of valuable forest products in the future. Good thrifty reproduction of desirable trees is the best guarantee of future production.

Most southern forests are deficient in all size classes, but particularly in the larger sizes. This is due to the practice of cutting trees just before they reach their most productive sizes. A tree 10 inches in diameter and increasing at the rate of 3 inches in diameter in 10 years is increasing its wood volume at the rate of 25 percent per annum, yet stands of trees in this size class are being cut heavily all over the South today. Stands of this size and smaller cannot be cut heavily without losing much in terms of forest growth and future forest production.

Successful forest management, however, cannot be based on cutting nothing until the growing stock builds up. For one thing, every forest of any size should be treated regularly to remove poor trees and to improve growing conditions in crowded stands. The forest should also produce enough to carry current expenses if at all possible.

The aim of the forest manager should be to develop a fully stocked forest with a good distribution of trees of all size classes, from small reproduction to large mature timber. He can accomplish this aim gradually through adequate fire protection, through thinnings and other cultural measures in immature stands, and, finally, by restraint on the amount of merchantable timber cut, particularly in the smaller sawlog sizes. He should plan to cut regularly; but until such time as his forest becomes fully stocked, annual cuttings should be less in volume than the annual growth. In this way he will gradually increase his capital in thrifty well-formed trees that will produce maximum returns in volume and in value increment.

SUSTAINED YIELD

Sustained yield is an important concept in forest management. It implies that a forest unit is to be managed continuously for steady annual production of forest products and that the aim of the forest manager will be to increase the production of the unit to the point of maximum returns. According to this concept the forester builds up his timber stand in the same manner and with the same objective that a farmer builds up his soil. Under this principle, liquidation of the forest by heavy cuttings would be considered not at all, or only in the face of some dire necessity. Removal of the immature growing stock would be comparable to the running of a productive farm by the wholesale removal of the topsoil, leaving the land waste.

The principle of sustained yield establishes as an ideal a forest that is fully stocked and productive, permitting each year a regular and substantial harvest of forest products and providing also that the future yields of forest products will be of similar or greater size, quality, and value. Such a forest, or one closely approaching this ideal, is a valuable property because it insures, in the absence of any severe catastrophe, a continuous supply of forest products. Permanent businesses and permanent communities can be established to utilize the products of such forests.

To manage a forest under sustained yield, certain principles must be followed. First, the annual cut cannot be greater, and should usually be less, than the annual growth. When the forest reaches full stocking, then annual cut should balance annual growth. But until such time arrives, the cut should be limited to something less than the growth. Second, the forest should have a relatively even distribution of all size classes, including reproduction, in order to insure that mature trees will be available for harvest cuts in the future.

ESTIMATING THE GROWTH

To make sure that a forest is being built up under the present management and not destroyed through over-cutting, the forest farmer needs to know at least roughly the growth on his tract as a guide to his annual or periodic cutting.

One method of estimating growth is by regular inventories. Under this method an estimate of the standing timber is obtained at the time the stand is acquired or first cut for improvement. At the time of the next cut, in say 5 years, a second estimate is obtained and the two are compared. The increase in volume during the period between cuts represents the growth and may be used to gage the size of the next cut.

Another useful method of roughly controlling the cut at the start of forestry operations is to use an assumed growth rate of 5 percent to 6 percent of the entire growing stock as the expected annual growth. Experience and studies have shown that second-growth Southern pine stands increase their volume at approximately this rate. If the volume of the stands is known, annual growth may be computed by applying such an assumed growth percentage. This method can be used without serious danger of over-cutting for the first cutting cycle of 5 to 10 years.

Where it is impracticable to provide regular cruises for the whole tract under management, growth can be studied on well-distributed sample areas. In choosing such sample areas, efforts should be made to obtain a good cross section of the whole forest with both good and poor areas well represented.

Other methods of estimating growth used by foresters require the use of a special tool, the increment borer. With a table showing the number of trees by each diameter class on an average acre and with a table of average diameter growth by sizes, it is possible to construct a new table showing the stand at 5 years or 10 years hence.

CROSSETT METHODS

A method of regulation of the cut in use on the Crossett Experimental Forest maintained by the U. S. Forest Service in southern Arkansas illustrates how stocking may be gradually built up while the forest is yielding a steady income. There the forest is divided into compartments of 40 acres. Each compartment is cut selectively on a cycle varying from 3 to 9 years. Before each cut the compartment is cruised and the growth since the last cut is determined. The objective of management is to raise the stocking to 10,000 board feet per acre, which is assumed to be about optimum.

All stands are cut regularly, however, if they carry a stocking of 2,000 board feet or more per acre. At this lower volume one-half of the growth that has accumulated is removed at the end of each cutting cycle. With stands of 10,000 board feet, all of the accumulated growth is cut, so that such stands start each new cutting cycle with the same volume. For stands of intermediate volume, the cut is in proportion to the growing stock. For example, for the stand having 6,000 board feet per acre at the end of the cutting period, half-way between minimum stocking and full stocking, 75 percent of the growth would be cut, leaving 25 percent to build up the stand.

This method permits a substantial income from all parts of the forest, yet provides for gradually increasing forest volumes. Some such method of regulation of the cut should be adopted to insure a steady buildup in stocking on understocked forest lands.

To practice forest management under sustained yield, it is essential that the annual cut or the cut over any period of 5 years or so be not more than the growth of the forest over the same period. Other provisions should be taken, however, to safeguard a continuous supply of products in the future. The most important of these is an adequate supply of reproduction of the desired species and the maintenance of good growth on all intermediate size classes by thinnings, stand improvement, and other silvicultural measures. Silvicultural work will be discussed in a later section.

MANAGEMENT PLANS

Under sustained yield, forests are usually cut and otherwise treated according to a plan of management which states the objectives of the owner; gives the acreage, volume, and distribution of the growing stock; and establishes a cutting budget and a cutting schedule. Such management plans are usually established for a period of 5-10 years with provisions made for revisions after the expiration of that period. At present few privately owned forests in the South are managed according to a written plan. Success in forest management cannot be said to depend on such a plan, but management would be systematized and improved by the use of simple written management plans.

To illustrate forest organization and planning of forest management, let us assume that the owner of 2,000 acres of unmanaged second-growth land in the shortleaf-loblolly pine-hardwoods type of the coastal plain region desires to place his holdings under forest management. His objective is to make a living from this land through forest farming while he builds up the growing stock and develops a fully stocked productive forest over the next 20 years. What are the logical steps to be taken in planning his operations?

FIRE PROTECTION FIRST

His first consideration will be adequate fire protection. He will, if possible, immediately put his land under the state fire-protection system. If no public forest-fire-protection system exists, he must provide his own. In either case he should plan carefully to cut down the risk of fires starting and to provide for the prompt detection and quick suppression of fires on or near his property. He will want to contact neighbors and adjacent owners to solicit their cooperation in fire prevention and suppression. He will provide telephone communication to inform him or his manager of the presence of fire. He will open up old roads, and perhaps construct new ones to make all parts of his holdings readily accessible. He will purchase fire-fighting tools and provide that they be readily available and in good condition in case of emergency. Finally he may organize and train his neighbors and workers into a fire-fighting crew.

There will be several advantages in preparing a written fire-protection plan covering the above and any other points which his analysis of the situation warrants. Such a plan, if revised currently, can provide a ready and useful check list and reminder for the owner on current seasonal jobs necessary in fire protection.

DIVIDE FOREST INTO COMPARTMENTS

With fire protection planned, the next consideration will be the order and extent of cutting. Income will be needed and all forests require regular cuttings to keep them in good growing condition. Where, when, and how much to cut is the question.

Tracts of 2,000 acres or more are, however, not easily known in detail. As a practical basis for collecting essential information and applying it in management, a forest should be broken down and organized into blocks and small compartments. For example, let us assume that the 2,000 acres lie in 3 tracts separated by other holdings. Each tract will be considered a block and will be given a name or number as Block I, II, III.

The next logical step is to break down each block into small compartments. Compartments need not be of any particular size, but under southern conditions an area of 40 acres is logical, particularly for those states where public land surveys exist. Compartment lines should be run out and the boundaries shown by clearly painted lines. A plat or map of each block can then be drafted and the compartments serially numbered. Compartment numbers painted on signs or trees will help in defining locations.

ESTIMATE TIMBER VOLUMES

The division of a forest into compartments will greatly assist in planning operations, giving instructions, and in otherwise administering the forest. To make the planning more complete and satisfactory, however, it is desirable to obtain a description of forest conditions in each compartment and an estimate of timber volumes. This estimate can best be made through a systematic cruise of the forest, compartment by compartment.

In this article no attempt will be made to describe methods of timber estimating. Yet these methods are neither so technical nor so difficult that a man with a fair education cannot rapidly acquire skill in this work. Other information of value can often be acquired at the same time as the estimate of timber volume; these include cut-and-leave tallies, type maps, and growth data.

All unmanaged stands contain trees of undesirable species, form, and condition. Even in understocked stands, clumps of timber will be found here and there that have too many trees for good growth. Accordingly, unmanaged second-growth stands--without exception--need an improvement cut. Frequently, such a cut will be profitable and sufficient for all income purposes for the first few years of management. During the cruise it is desirable to tally the trees that should be removed in such an improvement cut.

The location of forest-type boundaries is very useful information and will often be obtained in cruising. Forest conditions within a type often vary widely as a result of past cutting practices, fire, and other factors. After preliminary study a few broad conditions can be defined and the stands can be classified and mapped during the survey. Boring of sample trees with an increment borer to determine the width of the growth rings during the last 5 to 10 years is a useful method of obtaining growth data. Much of the information obtained on the cruise will be most useful if compiled on maps; these provide a compact and useful record.

Plan the Cut

When he has completed a cruise of the area, the manager is in good position to plan his cutting operations. He should adopt a cutting cycle, a period of years over which he wishes to make his first cut of the tract. Under intensive management, a cutting cycle of 5 years is desirable, although a longer cycle may be required. With a 5-year cycle, he will cut one-fifth of the area each year. On the sixth year he will return to the compartments cut during the first year.

If the improvement cut (as shown by the cut-and-leave tally) brings in sufficient income, the first cut should be confined to this class of trees. If not, it will be necessary to remove a portion of the desirable growing stock. The portion removed should consist of the less thrifty and larger trees, but in no case should exceed the estimated growth before the next cut.

Marking rules may be desirable if the owner or manager will not personally mark all the timber on the tract. These rules describe in simple terms the objectives of the marking and the classes of trees to be cut as a guide to the marker.

With a map showing compartments, types, forest conditions, and compartment volumes, and with a cutting plan and budget for the first 5 years, the owner will possess the essentials of a sound management plan. The plan may be developed further by descriptions of conditions and objectives, but this in most cases will be left for a later revision and development of the plan. All management plans should be revised periodically, usually at the end of each cutting cycle.

In this pioneering stage of forest management, few owners will find it practicable to go to all of the detail outlined. Often, a simpler approach must suffice. The above brief outline should, however, be of interest in indicating the direction which planning for better forest management should take.

CUTTING OPERATIONS

In forestry, the ax and saw take the place of the plow and hoe in tillage farming, and forest betterment comes principally from planned cuttings. Cuttings in forest management serve two purposes: first, they produce income for the owner; and second, they improve the form, composition, and growth of the timber stand.

Cutting in a managed forest should be continuous, with each part of the forest cut lightly every few years according to a planned cycle and cutting budget. Most such cuttings should return net income to the owner. Cuttings for culture alone, returning no income to the timber grower, and representing a capital outlay, as cleanings or early non-revenue thinnings, will be few. Cuttings which barely pay their costs but result in substantial gains in growth are, however, good business and should be encouraged.

Three questions will interest the owner planning on improving his forest with the ax. These are: when, what, and how much to cut.

Light, early, and frequent cuttings to remove poor trees and to improve growth conditions have generally been found good practice in forest management. On unmanaged southern forests, cuttings should be undertaken as soon as practicable; they should remove at first only the poorer and less desirable trees, and cuttings should be repeated on every tract at regular short intervals, say every 3 to 10 years.

How much to cut at first will usually be determined by the amount and number of undesirable trees and crowded stands, by the operability of the stand, and by the finances of the owner. Poor trees should be cut and crowded stands thinned, in any case; where additional cutting is necessary to make the operation practicable or to produce more income, other better trees should be removed. If additional income is not needed, most understocked stands would benefit from retaining all the good growing stock.

Success in building up a good growing stock will depend largely on the forest manager's skill in selecting trees for removal in the periodic cuts. Foresters classify cuttings in various ways, depending on the purpose or intent of the cutting. Below, some of the principles and practices ordinarily followed in several types of cutting are discussed.

STAND IMPROVEMENT

Cut-over and understocked forest lands are almost universally in need of stand improvement. Building up a good growing stock of thrifty, straight, desirable timber is the objective; to meet this it is necessary to cut poor species, badly formed trees of good species, trees that may die and go to waste if not cut, and other undesirable or unprofitable trees. Adequate seed trees for open stands should be a first consideration. With this requirement filled, the following classes of trees should be cut:

1. Poor species:--Hickory and gum in pine-hardwood stands, pond or "black" pine in slash longleaf, and bitter pecan in bottom-land hardwoods are examples of poor species that should be reduced as rapidly as commercial cuttings permit. With established objectives of management, other species may be classed undesirable and cut as soon as they reach commercial size.

2. Poor risks:--Trees that because of age, disease, defect or other condition cannot be given a reasonable chance of long survival should be removed in stand improvement. Trees showing signs of "red heart" or other serious decay, trees with large butt wounds, with poor crowns, hardwoods with large hollow branch stubs, worked-out turpentine timber, and the like should be included. Such trees may not be only wasted by failure to cut promptly, they also frequently hold back growth on promising trees.

3.--Trees of poor form:--Crook and sweep is a frequent defect in trees left from older cuttings. Minor crook or sweep is not serious, but trees that will never produce good logs because of poor form should be cut at the first opportunity.

4.--Wolf trees:--Earlier cuttings often resulted in leaving very scattered young trees. Such trees have often formed spreading crowns covering from 1/40 to 1/10 of an acre or even more. Such trees grow fast but are inefficient producers of wood because they occupy from 2 to 10 times their normal space and prevent growth of high-grade timber on the area they occupy. Such trees should be removed.

The above are only useful definitions in improvement cutting. With the objective of well-stocked thrifty stands of straight valuable timber, men with some timber knowledge will easily agree on the types of trees to be removed for stand improvement.

THINNINGS

Southern pine stands may start with as many as 10,000 trees to the acre, but at maturity 150 trees or less will remain. Death of trees is rapid at first, slowing down toward maturity. Without thinnings, a great loss of useful materials results--and sometimes a loss in volume growth as well. Thick stands should be thinned as soon as they contain some useful commercial product that can be removed at a small profit. Thinnings should be repeated thereafter every 5-10 years until the stand is mature.

Two methods of thinning are recognized, the choice depending largely on the end product sought. If large volume growth is wanted, then the larger dominant trees will be retained, and smaller trees underneath cut for salvage and to permit the crowns of the larger trees to develop properly. If high-quality sawlogs or piling is sought, cutting will remove the dominants, leaving the straight clean trees that have fair crown development. Obviously diseased and defective trees and trees of poor form should be removed in any thinning operation.

Crowns should be watched in thinning. Every tree should be given space to grow and develop into a larger tree. This can be accomplished by providing some room for crown spread at each cut.

A useful guide to spacing has been developed by H. C. Mitchell of the Soil Conservation Service. He recommends that to the diameter of a tree in inches the number 6 be added to obtain a guide to the proper spacing in feet. Seven-inch trees under this rule would be spaced about 13 feet apart, 10-inch trees 16 feet, etc. This rule should prove a useful guide in thinning southern pine stands.

HARVEST CUTS

Despite the general need to increase growing stock at the outset of forestry operation, it is often necessary to cut desirable trees, either to provide needed income, or to make the cutting sufficiently heavy to be economical. The principle to follow here is to remove the least desirable and most mature growing stock, leaving the young thrifty timber for development. Classes of timber that should be favored for income cutting include:-

1. Slow growers:--The forest farm is not a storehouse--it is a producer of wood. When a large tree slows down considerably in growth it can be sacrificed. With experience the slower growing trees can be spotted by appearance and taken out with least loss to the producing forest.

2. Large trees:--Even with fair to good growth, large trees should be considered for harvest. They have large volumes--one will give more income than several small trees. Further, they are increasing in volume at a much slower rate than small trees with the same ring width.

3. Trees in heavy stands:--Trees respond quickly to more room. Where additional income is needed, thinnings may be made a little heavier with confidence that the timber stand will adjust itself and produce as much wood per acre as before.

NON-REVENUE CUTTINGS

Certain cultural operations involving outlay of funds without substantial returns will be mentioned briefly:

Girdling:--A few large living trees too defective or too poor to be merchantable will be found on every tract. Sometimes young pines will suffer seriously from the competition of poor hardwoods a little larger and yet too small to market. Girdling is a quick, inexpensive means of disposal, and one that is not destructive to nearby young trees. Girdling cost varies from 2 to 4 cents per tree and usually is a good investment.

Pruning:--High grades in lumber are scarce and profitable to the manufacturer. Some early pruning, especially of limby pine stand is, theoretically at least, an investment of promise, and should be considered by those primarily interested in growing high-grade products. Pruning of hardwoods is usually not recommended.

Cleanings:—Sometimes pine reproduction is so badly choked by overstory hardwoods that the stand will fail without some assistance. Under these conditions, a cleaning to top or set back the hardwood in favor of the pine may be desirable. Such operations are expensive and should usually not be considered unless the reproduction is necessary. Brush hooks, hatchets, or light axes are the tools used, and the work is limited to giving the good species "headroom".

FOREST MANAGEMENT SYSTEMS

At the start of forest management on any understocked southern forest, cuttings will be in the nature of improvement cuts aimed at a general improvement of stand conditions. Sooner or later however a decision must be reached on the form of forest which is to be developed or maintained. Will it be an even-aged type of forest with all trees on a given compartment of approximately the same size or age? Or will it be all-aged, that is, with trees of all ages and sizes mixed throughout the stand?

The objective under any method of management is to have an even distribution of ages and sizes; only through such distribution can an even, uninterrupted cut be assured. In general this specification can be met in one of two ways. We can arrange to develop the forest toward a series of even-aged compartments, each of a different age class from young reproduction to mature trees. Under this type of management one or more compartments would be harvested and regenerated each year. On the other hand, we can plan to have each block contain all tree sizes, harvesting the mature timber from each block by returning for a light cut every few years. Which system should we use with southern timber?

TOLERANCE OF SHADE IMPORTANT

There are over fifty commercial trees native to the South. Each species has its individual requirements for light, soil, and moisture. Some trees are flexible in their requirements and can be managed under one of several systems and on various types of land. Others have very rigid requirements for reproduction and growth and can be managed successfully only under conditions and under methods adopted to these special requirements.

Some trees are highly intolerant; that is, they refuse to grow and develop in their own shade or in the presence of other trees or even of grass or brush. A good example is longleaf pine, which seldom sends up a seedling within 30 feet of a large parent tree. Cottonwood, which will thrive and grow in thick stands only on the barren sand bars laid down by the larger rivers, is another. These species are not adapted to all-aged forest management; they can be grown successfully only in even-aged groups or stands.

Many trees are intermediate in tolerance; that is, they like the sun and can grow well in full sunlight, but they can also stand more or less shading, developing slowly, but recovering rapidly when released from competition and, frequently under these conditions, making clear, straight, highly valuable trees. Most of our pines--shortleaf, loblolly, and slash--are in this class. Most southern hardwood trees also fall in this category.

Finally, we have some highly tolerant trees, which seem to do best, in their early years at least, under shade. A good example is red gum, which will persist and develop under a complete pine overstory. Other highly tolerant hardwoods such as holly, sourwood, dogwood, are not of great commercial importance.

Highly tolerant trees are well suited to the selection type of forest, the ideal condition in all-aged forest management. Such trees reproduce well under their own shade and these species rapidly develop into selection forests when so managed.

Most of our important commercial trees are intermediate in tolerance. From what is now known, these trees can logically be managed either in all-aged or even-aged stands. Eventually the profits and other advantages of handling either as even-aged or all-aged will be more apparent; in the meantime, no strong objection can be raised to management under either system.

Forest succession has an important bearing on choice of management method. As every woodsman knows, tolerant trees that establish themselves under other trees may become a problem when the overstory timber is cut. Under the principles of plant succession these more tolerant trees would eventually dominate the forest in the absence of fire, cutting, or other disturbing influence. It is the forester's job often to control this trend toward inferior tolerant trees, with the ax and with fire, machinery, or other cultural tools. A good example is the shortleaf-loblolly pine-hardwood type where cutting of pine, and only or mainly pine, will lead to a stand of hardwoods, relatively poor and worthless. Some foresters claim that any all-aged system in this type will result in a gradual increase of hardwoods, leading to the same end result. On the other hand, other equally well-informed men plan confidently on fighting hardwoods in these stands successfully and have good examples of successful work to prove their point.

For most southern trees a fully stocked even-aged forest can be highly productive. Such a forest might be expected to produce as much as 600 board feet per acre per annum from mature timber alone while producing, in addition, considerable volume of pulpwood and other small and intermediate sized wood from thinnings. The principal drawback at present to this type of management is the run-down condition of much of our timberlands and the problems involved in shaping the forest into this desired form. Most southern timberlands available for good forest management have been overcut and present a spotty and uneven-aged form. To get these forests into productive condition as rapidly as possible requires protection and restraint in cutting all desirable growing stock. The forest that results from this type of common-sense treatment applied to neglected stands is usually non-uniform in character and essentially all-aged rather than even-aged in composition. To change this mixed, essentially all-aged forest into an even-aged stand is at best a slow process. If an attempt is made to force the forest into an even-aged form, serious loss of growth may result.

Some of the early claims for selective cutting and all-aged management were unsound, but there is one outstanding advantage of this form of management--it is a natural system and one easily applied to our present understocked stands. These are often more all-aged than even-aged because of past cutting and fires and the tendency of natural forests to reproduce themselves in small blocks of the same age rather than in large blocks. The forester must often fight natural trends in the forest, but the wise fight nature only when they must!

So in our present forests, it often seems wisest to adapt what we have rather than to revolutionize the forest--to protect and culture our present growing stock rather than to cut it back. This tendency will often lead a forester toward an uneven or all-aged type of forest in the South today. This is satisfactory if it does not lead to forcing a tree into a system to which it is unadapted or to serious encroachment by inferior trees.

Some stands have so many inferior trees that to carry along such stock is obviously foolish; these stands should be cut back as soon as possible and regenerated in the most economical way to good species. This treatment will frequently result in even-aged stands.

COMPROMISE POSSIBLE

There is a compromise, and a good one, between all-aged and even-aged management. It is usually called group selection, and it consists of growing trees in small even-aged groups. This system partakes essentially of both methods--it is run on a cutting cycle with one or more mature groups cut in each compartment every few years. The groups, on the other hand, may be truly even-aged and fully-stocked. While such a system of small groups would not work too well with a highly intolerant species, such as longleaf pine or cottonwood, it would work well with most trees of the intermediate class of tolerance.

Regardless of the form in which the forest is to be placed eventually, there can be little argument on the need for cutting now in the understocked neglected stands that we have in the South, following the principles discussed. Call that cutting "selective" if you will, but remember it is just the commonsense treatment of presently unmanaged stands. After one or even two cuts of this kind is the time to decide on the future form of stands. The forest will be shaping up and the decision should be easy considering what you, the owner, have and want to grow. Foresters will still be arguing pro and con, and these arguments may help or confuse you. In either case, you will decide best and most wisely if you study your own woods and your own needs.

SILVICULTURAL SYSTEMS

Foresters have developed several methods of harvesting timber to permit restocking of stands to thrifty reproduction. Although few second-growth stands in the South have reached the stage of heavy harvest cutting, forest farmers should know something of the various silvicultural systems for possible future use. There are in all five distinct silvicultural methods: selection, clear-cutting, seed-tree, shelterwood, and coppice. A description of each method and a short discussion of the advantages and disadvantages of each follow.

SELECTION SYSTEM

Only one silvicultural method, the selection system, is adapted to the management of uneven or all-aged stands. Under this method cuttings are planned to develop on each acre trees of all sizes and ages. Harvest cuttings are made on a short cycle from 3 to 10 years, and 1/3 to 1/10 of the entire forest is accordingly marked for harvest each year. At each harvest some of the largest trees are removed, the amount being controlled by the growth of the stand since the last cutting.

All cuttings under the selection system are relatively light and the yields per acre low. As a result logging costs under this type of management are usually somewhat higher than with other forms of cutting. On the other hand, the selection system appears to be well adapted to the management of the cut-over, understocked, and neglected stands of the South which are frequently all-aged in character.

The selection system favors reproduction of tolerant species in preference to trees that are less able to stand shade and other competition. Accordingly, this type of management may create problems in mixed stands of pine and hardwoods where the objective is to grow pine. Eventually the more tolerant hardwood reproduction will tend to crowd out the pine without expensive cultural treatments.

Some of the disadvantages of the true selection system may be overcome by a slight modification. As mentioned in the previous section, cuttings can be made in small groups rather than by individual trees, thus permitting reproduction to develop without serious interference from overhead shade. The group-selection method has much to recommend it in the management of second-growth stands developing from past lumbering operations. Such stands are often patchy in form with small groups of trees of various sizes found on the ground. As these groups reach maturity they can be removed to create small openings where the reproduction can develop without serious interference from larger trees above.

CLEAR-CUTTING

Clear-cutting is a system used in many European countries where reproduction is provided by planting the desired species following harvest. As practiced there, the ground is cleared of all trees, including small poles, and the new crop is planted immediately thereafter on the bare lands. This system has found little application so far in this country, because of the expense of planting.

Clear-cutting can also be used when dependence is placed on natural reproduction. In such cases a seed supply must be provided. This may be accomplished by confining the cutting to strips of 200 to 500 feet width. Clear-cut strips are ordinarily located at right angles to the prevailing wind direction to permit good distribution of seed from the uncut margins.

Occasionally a progressive system of clear-cutting is used in which the strips are cut across the compartment in the direction of the prevailing winds in successive periods. Under some conditions the clear-cut areas are in the form of patches or blocks.

Clear-cutting methods have special applications to poor rundown stands where the amount of inferior timber is such that the possibilities of developing a good stand by other methods seem remote. Under these conditions, the best opportunity for recovery may be to clear the land of its overburden of poor material and to regenerate it either naturally or artificially to young trees. Under this system radical soil treatments such as burning, bulldozing or similar measures to get the stand in shape for regeneration can be readily provided without damage to timber being left for future growth.

SEED TREE

The seed-tree method is comparable to clear-cutting except that individual seed trees sufficient to reproduce the area are left. This method is usable only with wind-firm, prolific, and light-seeded species. Most of our southern pines fill this requirement and this method may accordingly find rather wide applications in the South.

Sometimes seed trees are left in small groups rather than as single trees, a slight variation in the method, used ordinarily with species which are inclined to windfall.

SHELTERWOOD

One of the more complex methods of silviculture, shelterwood is adapted to use with heavy-seeded species and particularly with species that require or benefit from the shade of a light overstory in the reproduction period. In this method the mature or nearly mature stand is thinned down gradually to a partial stand of large seed producers. As the reproduction becomes well established, the shelter trees are removed in one or more cuts. In its simplest form the shelterwood system is closely comparable to a heavy seed-tree cutting.

Southern pine thrives under full exposure to sun, and it is improbable that the true shelterwood system will find much application in the harvesting of these species. Principal use of this method will undoubtedly be in management of hardwoods, particularly where it is desired to convert a mixed stand of hardwoods to a more uniform stand of one or more species.

COPPICE

In this silvicultural method, reproduction is obtained not from seed but from the sprouts of the trees cut. It is essentially clear-cutting with sprout reproduction, and its use is confined to sprouting species. Because older trees lose their capacity to sprout vigorously, the method is adapted only to small trees grown on a short rotation. It has been used successfully in growing fuelwood, chemical wood, and other low-grade hardwoods. Large cubic volume returns are possible, but the quality of the product is relatively low.

Owners of southern pine lands will be interested principally in the selection, seed-tree, and clear-cutting methods. For hardwoods the selection, shelterwood, and occasionally with certain light seeded species, seed-tree and clear-cutting will apply.

Although harvest cutting will not be an important problem at the outset of forest management, every owner will be faced sooner or later with a decision on type of cutting to follow. In harvest cutting revenue is important, but so also is the successful reproduction of the land to a new tree crop, and cutting should be carefully planned with this end in view.

APPLICATIONS TO SMALL OWNER

The principles of forest management have been briefly discussed, and some applications of them have been suggested to the owner of forest land, who is interested in sustained forest production. Now a summary will be attempted, bearing in mind the needs of a small forest-landowner who wishes to practice forest management, but must operate without the services of a technical forester. It will be assumed that this owner is a forest farmer, that he lives on or near his property, that he can give his forest regular attention, and that his objective is to produce the maximum financial returns from his property in the form of various classes of wood products.

Because of fires and overcutting, forest land in the South today is generally understocked in regard to the capacity of the land to bear timber crops. Inasmuch as production of a forest is mainly dependent on the quality and amount of stocking, the first objective of the forest owner should be to improve both the quantity and quality of stocking or, in other words, to establish a full stand of desirable trees of good form and quality.

To meet this objective fire protection must be provided, without it, good reproduction can be neither established nor maintained. State fire protection, where available, will be of great advantage, but the owner interested in intensive management should take additional steps to safeguard his land from fire. Such steps may consist of making all parts of the forest readily accessible, constructing boundary and other fire-breaks, and providing adequate fire-fighting equipment and for assistance in case of emergency.

PLANNING THE CUT

After providing for better fire protection, the next step in forest management should be the organization of the forest and the planning of cutting operations. It is desirable to divide the forest land into compartments of about 40 acres, giving each compartment a number or some other designation.

Following subdivision of the forest, a cruise of each compartment to give detailed information on the location of timber types, amount, quality, and character of the timber stand, and information on growth is desirable. Detailed cruises of this type will require the temporary services of a forester on a consulting basis. Where a forester can be employed, the owner may obtain a map of the area showing timber types, compartment boundaries, locations of roads, streams, and other important land features, an estimate of the total standing timber by diameter classes for each compartment, and a separate estimate of the timber that should be removed immediately to improve the growing stock and provide income.

The above information can provide a sound basis for managing the tract for 5 to 10 years or more. Where such a detailed cruise is impracticable, the owner may train himself to make simple estimates of timber volumes. Or he may proceed with only such general information on the character and volume of the timber stand as he can obtain through close examination of each compartment. Although detailed cruises and written plans are desirable, they cannot be considered essential, for many owners of forest properties have made good progress without such aids. The forest farmer who cannot hire a consulting forester can often obtain valuable advice from the State Forester or Extension Forester. Although these public foresters cannot give long periods of service to individual owners, they can advise on particularly knotty problems, and train the owner in forestry methods.

CUTTING UNDERSTOCKED STANDS

Cutting in typical understocked stands should, in the beginning of forestry operations, be restricted largely to the removal of inferior trees that do not make good growing stock. Poor species, diseased and defective trees, large-crowned "wolf" trees, and trees of poor thrift (which may die before the next cut) are examples of poor growing stock that should be removed in early cuttings.

In addition, it is desirable to thin in heavy stands of small pole size and larger. Where these classes of timber are insufficient to provide an economical operation, it is sometimes necessary to cut a few mature or near-mature trees. The desirability of increasing the growing stock as rapidly as possible should, however, be kept in mind; and the cutting of healthy desirable growing stock should be kept to a minimum.

To provide adequate control, trees to be cut should be marked by the owner or some qualified employee. The harvesting of forest products by the owner and his employees is also desirable. This permits better control over logging damage and encourages the harvesting of more than one product--for example, sawlogs and pulpwood--in a single operation.

The success of a forest operation will depend largely upon the successful marketing of the various products removed for the benefit of the timber stands. Close study of the local possibilities of utilizing wood products, particularly those for low-grade material, will necessarily be an important part of the forest farmer's activities. A man who is in a position to produce various classes of material such as posts, poles, piling, fuel wood, and cross ties can ordinarily get the largest income from his woodlands and can at the same time leave the timber stands in good growing condition by removing most of the defective and undesirable trees at a profit.

The removal of defective trees, trees of poor species, and other undesirable growing stock should proceed as rapidly as practicable. The amount of good growing stock cut in an understocked forest should not, however, exceed the growth, and it is preferable that it be confined to one-half the growth or less until full stocking is reached. It is not good business, however, to leave a stand without any cutting for a long period, say more than 10 years. Young growing trees soon become too crowded for best development, and some sound trees become injured and diseased. Frequent light cuttings are to be encouraged, therefore, to keep developing stands in good growing condition. It is desirable to plan and organize cutting so that the forest returns each year a sufficient income to meet current carrying charges.

Because of the spotty, uneven character of stands found in most second-growth woodlands, the forest developing under management will often be more or less uneven-aged, with small patches of reproduction interspersed among older trees of various sizes. Under these circumstances it will be logical to continue the uneven-aged form of forest through selection cutting of either single trees or groups if the desirable species will reproduce satisfactorily under these methods. Where the species are intolerant, however, the gradual conversion of the stands to even-aged blocks will be desirable.

THE FUTURE OF FOREST MANAGEMENT

Forest management in the South is still relatively new, and the form it will take for the various forest types is still largely a matter of conjecture. With experience and research in managing southern timberlands, the most desirable forms of management for the various forest types will gradually develop.

Experience to date, however, indicates clearly that for the typical understocked southern stands, forest-fire protection and one or more light cuttings to improve the quality and spacing of growing stock is sound forestry practice. Reseeding of openings in thin stands is ordinarily prompt, and with successful fire protection the forest stocking usually improves remarkably, often approaching the optimum. With adequate stocking established, and with a developing forest furnishing regular income to the owner, the benefits of forest management are so apparent that such established units will unquestionably be continued as constant producers of wood.

Although the financial benefits of forest management are usually not immediate, the long-time returns are so attractive on good sites that they attract many farsighted Southern people. With a rapidly diminishing supply of virgin timber, both the demand for forest products and financial advantages of growing timber in this country should increase; and the South, with its many outstanding advantages in timber growing, should lead the Nation in the development and practice of good forest management.